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SHIMAGATSUO NO AMIME SENTAKUSEI NI TSUITE (ON THE SELECTIVITY p. 52
OF GILLNET FOR POMFRET)*

Kenji SHIMAZAKI**, Seiji SASAKI*** and Shoichi YAMAMOTO***

Hokkaido Daigaku Suisangakubu Iho (Bulletin of the Faculty of Fisheries, Hokkaido University), 32(1), 52-60, 1981.

Introduction

Recently, the Training Ships "Hokusei Maru" and "Oshoro Maru" of Hokkaido University have been operating experimental fishing during summer in the subarctic ocean front. In this experimental fishing operation, research gillnets≠ were used with various mesh sizes representing a geometrical progression of common ratio 1⅘ [1),2)]. These nets were made for salmon as nonselective gillnets.

Many species of fish are caught in these gillnets. p. 53
In particular, the catch of pomfret (Brama japonica HILGENDORF) was especially large indicating a large biomass [3),4),5)]. Pomfret is an important species as a constituent of the

≠ translator's note : literally : "drift nets" in the entire original text

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ecological system which migrates from the subtropic region to the subarctic region from spring to summer. Recently, this species has been noted as a promising resource yet to be developed.

In order to clarify the distribution, the biological composition and the relative abundance of pomfret, it is necessary to study first of all whether or not the amount of catch and the values of biological measurements obtained by the fishing gear used can be used as unbiased estimated values.

From the viewpoint stated above, the selectivity curves of mesh sizes for pomfret and the composite curves were obtained using the samples obtained by the experimental fishing done by the Hokusei Maru in the summer of 1980. The gillnets used were also studied. The results obtained are reported below.

We would like to thank Dr. Teruo ISHIDA of the Hokkaido Salmon Hatchery, Fisheries Agency for his guidance and each member of the Hokusei Maru for his cooperation in the collection of data.

Data and method

From July 26 to August 7 in 1980, the Hokusei Maru undertook experimental fishing operations from 38°N to 48°N along the line 175°30'E from north to south using gillnets with 20 mesh sizes from 25 to 233 mm. Included in these 20 mesh sizes are 10 mesh sizes from 48 to 157 mm designed so

Table 1. *Detail of gillnets used for experiments.*

Stretched mesh	Length of float line	Hunging		Depth in net	Thread	
42	52.7	U 45%	L 47.2%	5.1 m	Nylon mono,; Nos.	4
48	50.5	〃	〃	6.5	〃	6
55	〃	〃	〃	6.7	〃	6
63	〃	〃	〃	6.6	〃	6
72	〃	〃	〃	6.7	〃	6
82	〃	〃	〃	6.7	〃	6
93	〃	〃	〃	6.7	〃	6
106	〃	〃	〃	6.9	〃	8.5
121	〃	〃	〃	6.8	〃	8.5
138	〃	〃	〃	7.1	〃	8.5
157	〃	〃	〃	7.3	〃	8.5
179	〃	〃	〃	6.3	〃	8.5
204	〃	〃	〃	6.4	〃	8.5
233	〃	〃	〃	6.3	〃	8.5

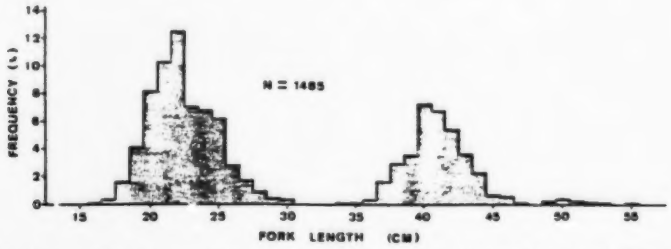

Fig. 1 Size composition of pomfret caught by different meshes in the North Pacific Ocean in late July – early August, 1980.

that they work nonselectively for salmon with fork length 25-70 cm and closely to the above 10 sizes, 4 mesh sizes with common ratio 14 %. The number of tans* used for each mesh size was 3 and totalled 42 tans. Details for the fishing gear are given in Table 1. p. 54

All pomfret caught in this series of gillnets were measured according to the mesh size. From the observation at all experimental stations, two modes in the composition of fork length (hereinafter referred to as body length) were recognized as shown in Fig. 1, one at about 22 cm (hereinafter referred to as the small-sized group) and the other at about 40 cm (hereinafter referred to as the large-sized group). p. 55

* translator's note : a unit strip of netting

Therefore selectivity curves were estimated for each group. For the small-sized group, since 619 were caught at one experimental station, measurement data of this station were

Table 2. *Size composition of small pomfret caught by different meshes of research gillnet.*

F.L (cm)	Mesh size (mm)														
	42	48	55	63	72	82	93	106	121	138	157	179	204	233	Total
16.0-16.9					1										1
17.0					3	1							1		5
18.0			1	5	5	8				2					21
19.0				12	22	22	2				1				59
20.0		2		16	33	49	8								108
21.0			1	10	28	47	48	1	1		1		1		138
22.0		1		3	28	50	65	4	1		1				153
23.0					6	20	35	1						1	63
24.0					2	5	17	11							35
25.0					2	9	9	5							25
26.0						2	3								5
27.0					1		1								2
28.0							1								1
29.0					3										3
Total		3	2	46	134	213	189	22	2	2	3		2	1	619

Table 3. *Size composition of large pomfret caught by different meshes of research gillnet.*

F.L (cm)	Mesh size (mm)														
	42	48	55	63	72	82	93	106	121	138	157	179	204	233	Total
34.0-34.9											1				1
35.0											1				1
36.0									4						4
37.0					1				8	5	7	3	1		25
38.0								1	9	13	13	6	1	2	45
39.0									9	14	14	15	1		53
40.0	3		1		1	1	1	1	6	18	44	25	4	3	108
41.0	3					2	3	2	5	16	40	25	1	4	101
42.0	1			2	2			4	5	16	26	13	11	1	81
43.0	1		1		1	3		1	3	11	18	12	3		54
44.0					3	1		1	2	5	13	7	2	1	35
45.0					1			1			2	3	3		10
46.0							1	2	1		1	1	1	2	9
47.0									1						1
48.0															
49.0									2		2		1		5
50.0									6						6
51.0									2				1		3
52.0													1		1
53.0													1		1
54.0															
55.0													1		1
Total	8		2	2	9	7	5	13	63	98	182	110	33	13	545

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used (Table 2) for estimation. For the large-sized group, not many fish were caught at one station so the measurement data from all stations were used (Table 3). Furthermore measurements of girth were taken for 142 fish.

In this report, Ishida's method was used for the estimation of selectivity curves[6].

Results and discussion

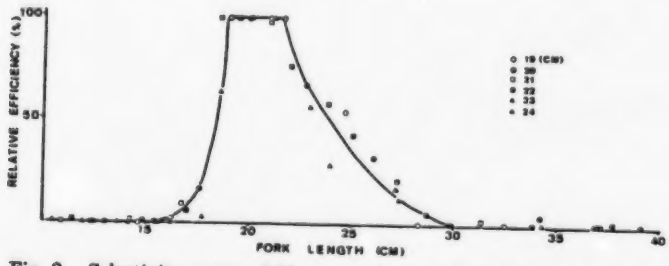

Fig. 2. Selectivity curve of 82 mm mesh size gillnet for small pomfret.

The small-sized group and the large-sized group caught in the gillnets with 14 mesh sizes representing a geometrical progression of common ratio 14 % showed a dependence on the selectivity of mesh size. The small-sized group was caught at about 82 mm and the large-sized group at about 157 mm. Since the body lengths of two groups had different modes as shown in Fig. 1, selectivity curves were obtained for each group.

Small-sized group: For the range of body lengths 19-24 cm in Table 2, a selectivity curve of 82 mm mesh size was obtained and is given in Fig. 2. Satisfactory values were obtained from the body length group used for drawing the curve.

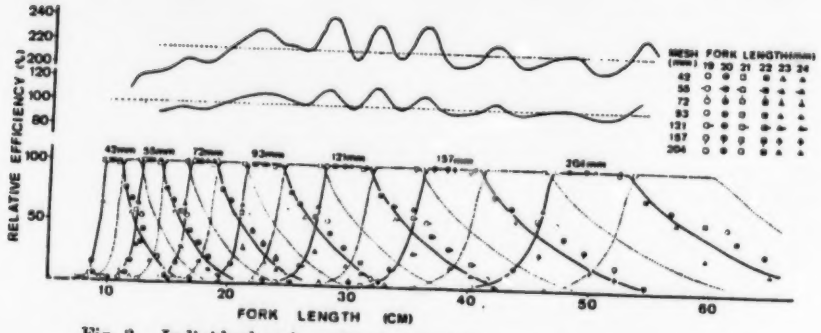

Fig. 3. Individual and combined selectivity curves for small pomfret.

This selectivity curve has a sharp inclination at the bottom left. When the body length increases more than 17 cm, the relative efficiency increases rapidly and the efficiency reaches 100 % after a width of 2 cm in body length. The range of most suitable body length is up to about 21.5 cm. The curve at the right bottom decreases more gradually than that at the left bottom and its upper limit is about 30 cm. Therefore it seems that the most suitable body length for the best efficiency with 82 mesh size is about 20 cm. Ratio K of this mesh size to the most suitable body length is 2.44[7].

If there is any bias in the samples obtained because of the mesh sizes of gillnets used, the relative abundance of this species and the examination of composition are meaningless. Therefore it is necessary to study whether we can regard the composition obtained by the research gillnets of the Hokusei Maru as a characteristic of its area or whether there any misgivings of over or under valuation. In order

p. 56

to clarify this matter, selectivity curves of 14 mesh sizes were obtained. Then a composite selectivity curve was obtained as shown in Fig. 3. In reality, as seen from Table 2, 98 % of the catch was taken by 5 kinds of mesh sizes between 63 and 106 mm, especially large at 72, 82 and 93 mm and very small below 55 mm and over 121 mm. The composite curve obtained was almost flat in the range of body length 14 to 54 cm. The mean value was 215.3 %, deviation 15.2 and the coefficient of variation of the compound relative efficiency was 7.04. This is lower than the coefficient of variation of pink salmon obtained by Takagi[8] using 10 kinds of mesh sizes between 48 and 157 mm from Manzer's basic selectivity curve. Therefore it is thought that the research gillnets made of nets for salmon with 10 kinds of mesh sizes and 4 kinds with the same common ratio of 14 % work nonselectively for the small-sized pomfret.

Large-sized group: A selectivity curve of 82 mm mesh size was obtained for the body length ranging from 40 to 44 cm in the large-sized group obtained from all the experimental stations. It was estimated as in Fig. 4. Although the catch was largest with 157 mm mesh size, the selectivity curve of 82 mm was obtained as it made it easier to compare the curves from the small-sized group and the large-sized group since the relative efficiency does not change with mesh size.

Points of each value measured for the large-sized group indicated a large amount of scatter compared with those

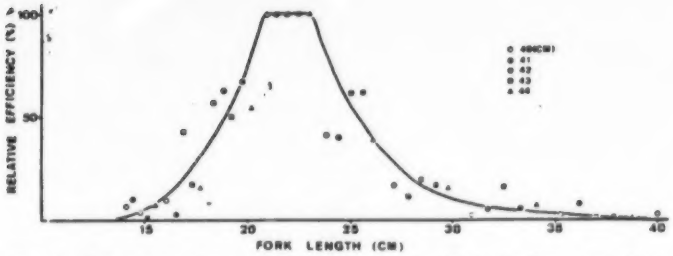

Fig. 4 Selectivity curve of 82 mm mesh size gillnet for large pomfret.

for the small-sized group. Therefore it was thought that the accuracy was low. However, the most suitable body length was about 22 cm and the relative efficiency decreased to the left and right almost symmetrically. There were no points below 14 cm on the left bottom. This was because the mesh sizes over 233 mm were not in use. However, it can be thought that the relative efficiency becomes 0 below this body length. On the right bottom, when the relative efficiency became less than 50 %, it decreased gradually and the curve stretched longer to the right compared with that of the left bottom. K value for the large-sized group was 2.68. p. 57

For the reasons given above for the small-sized group, a selectivity curve of each mesh size was obtained for the large-sized group. The composite selectivity curve is given in Fig. 5. In reality, as given in Table 3, about 90 % of the catch was in the range of 121-204 mm. The catch was very small with 8 kinds of mesh size under 106 mm and with size 233 mm. The composite selectivity curve thus obtained was almost flat in the range of body length 16-52 cm with the

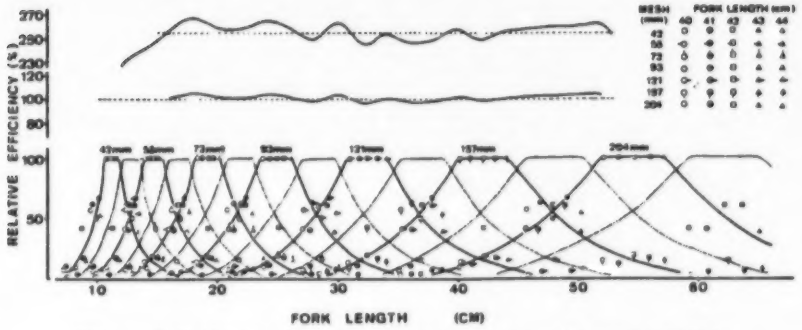

Fig. 5 Individual and combined selectivity curves for large pomfret.

mesh size used. The mean value was 255 %, the deviation 15.2 and the coefficient of variation of relative efficiency 2.50. This is lower than that for salmon[8),10)]. Therefore it can be thought that the research gillnets used by the Hokusei Maru also work nonselectively for the catch efficiency of the large-sized pomfret.

So far the mesh size selectivity curves and the composite selectivity curves obtained from the former were estimated for the small-sized group and the large-sized group. The details of the distribution of pomfret is reported in the another report. However, within the research range of the Hokusei Maru, there is a characteristic that the distribution of small-sized group is large in the subarctic ocean front and in the northern limit the large-sized group alone is found. Both groups are mixed on the latitudes in between.

In these areas where groups with different composition are distributed, when the groups obtained by the research

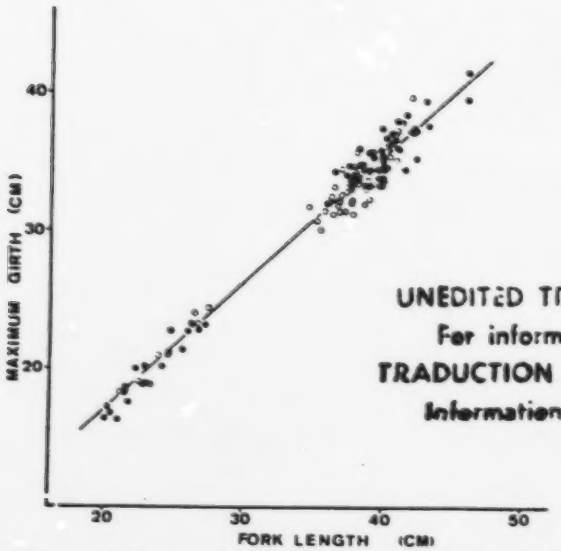

Fig. 6 Relationship between fork length and maximum girth of pomfret.
○ Female ● Male

gillnets are analyzed, it is necessary to compare the selectivity curves for the small-sized group and the large-sized group. From the selectivity curves in Figs. 2 and 4, the curve indicates a sharp inclination on the left bottom for the small-sized group. On the other hand, the curve for the large-sized group indicates a gentle one. For salmon, this difference in shape is thought to be influenced by the degree of fatness[1),2),11),12)].

The degree of fatness of the large-sized group in which the most suitable body length is to the right is supposed to be lower than that of the small-sized group. The degree of fatness (body weight x 10^6/body weight^3) for the small-sized group is 18.50 ± 1.38 and 18.70 ± 1.39 for the large-sized

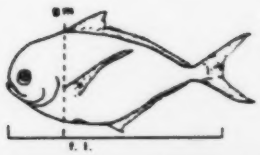

Fig. 7 Part of the maximum girth (g.m.)

group and is slightly higher. The girths were measured in order to compare the relationship of girth to body length which influences the gilling most. Their relation to the body lengths are given in Fig. 6. The location of measurement is given in Fig. 7. This location is regarded as that of the maximum girth.

From Fig.6, a relationship expressed as an equation p. 58 of the first degree is estimated to exist between two groups. The equation is expressed as below.

$M = -1.13 + 0.91L$ $r = 0.998$ (M: maximum girth cm, L: fork length cm)

Since no significant difference was found between the regression equations for male and female, both were combined.

The relationship between body length and girth for the small-sized group and the large-sized group is expressed as a straight line. It is thought that the girth of two groups is in proportion to body length.

Therefore the difference in the most suitable body length for both groups is due to some factor other than the difference in the girth and the degree of fatness. That is,

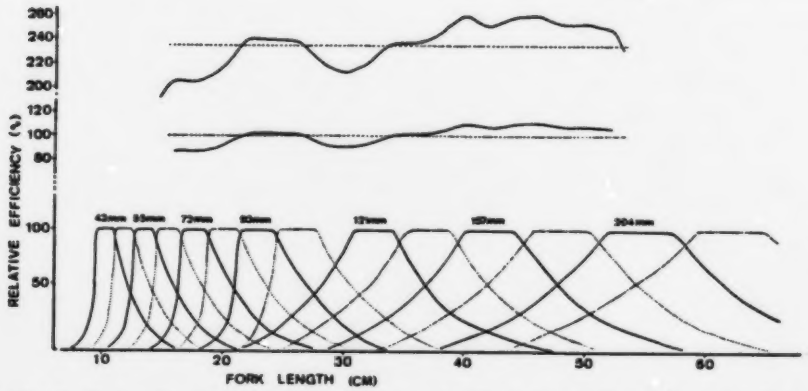

Fig. 8 Composite selectivity curve of research gillnet for small and large pomfret.

many small pomfret showed a constriction due to the net thread at the part where they were caught. On the other hand, the large-sized fish did not show a constriction due to their hard scales. Furthermore their ability to swim may be stronger than that of the small-sized fish. At the upper limit of the range of the small-sized group caught in the net, the large-sized group may escape through the mesh. Therefore it is possible that the range of the most suitable body length shifts to the larger side. It is thought that the structure of the net and its relationship to the stretchability of the thread as given in Table 1 and the direction of the net when gilling the fish and that of when hauling it are also influencial. It is also assumed that the suitable part of the fish caught by the net where the catch is successful may change. In this experiment we did not obtain the data concerning the part of the fish caught by the net therefore we cannot discuss this

subject here. However, this should be studied in future.

As stated above, the mesh selectivity of the small-sized group and that of the large-sized group indicated differences in most suitable body lengths and different relative efficiencies. When the research gillnets which resulted in the different relative efficiency for the two groups are used, the question of whether the samples showed a bias or whether the nets work nonselectively for the samples has a significant meaning. In order to study this aspect, a composite selectivity curve combining the two groups was obtained (Fig. 8) using the selectivity curves of the mesh size smaller than 106 mm which was the main catch range for the small-sized group and those of the size larger than 121 mm for the large-sized group (Figs. 3 and 5). The figure indicates the compound efficiency for pomfret of body length from 16 cm to 52 cm. As stated previously, the mesh selectivity curves of the two groups differ. Therefore the efficiency somewhat decreased at the body length 30 cm and increased over 35 cm. The mean value of the compound relative efficiency was 235.2 %, p. 59 the deviation 18.2 and the coefficient of variation 7.72. This is about the same as or a little lower than the coefficient of variation for pink salmon and white salmon. Considering that the catch efficiency for the large-sized group is a little higher, it can be thought that the relative abundance of pomfret caught by the research gillnets and the composition of the body length of the catch reflect the

research area nonselectively.

One of the authors of this paper is analyzing the distribution and the ecology of pomfret in the North Pacific Ocean. According to his study, in summer, only the two groups stated above have been collected[3] in the subarctic ocean front and in the northern area and there has not been no example of a medium-sized group collected in great quantity. Since it was suggested that the research gillnets work non-selectively for pomfret, it could be concluded that the composition of the body length given in Fig. 1 reflected the composition of the research area and that no group composed of the body length of about 30 cm was distributed in the area.

Mesh selectivity curves ware obtained for sardine (Sardinops melanosticta) and herring (Clupea harengus) by Ishida[7], for several species of fresh water fish by Ishida and others[13] and for white fish by McCombie and Best[14] using Ishida's method. The selectivity curves differed according to the fish species. For salmon, the selectivity curves differ according to growth stage and season not only among different species but also for same species[8],[9]. It is clear that the selectivity curve is influenced by the difference in body form according to species and according to sex, growth stage and seasonal change of the degree of fatness within a same species. For pomfret, the selectivity differs according to the size of fish in spite of a resemblance in

the body form. Therefore it is thought that the selectivity is influenced not only by the factors stated above but also by the swimming ability, the muscle texture and the method of using fishing gear. It is necessary to analyze the characteristics of the fish being caught by the net including the factors stated above.

Furthermore the mesh selectivity for other species of fish which are caught at the same time as pomfret may differ. Therefore comparisons of the biomass of different species should be studied with a close examination of the compound efficiency by species.

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Abstract

It is important to obtain unbiased estimates of the relative abundance, age and size composition etc., of pomfret (*Brama japonica* HILGENDORF).

This paper analyzes the results of the 1980 experimental fishing operations using research gillnet (mesh; 42, 48, 55, 63, 72, 82, 93, 106, 121, 138, 157, 179, 204, and 233 mm). These fourteen mesh sizes represent a geometric series averaging 14%.

In this experimental fishing. it was a rule that the some number to tans of nets should be used for each mesh size, and that all fish caught should be biologically measured. Length frequency data indicate the presence of two modes (22 cm and 41cm). Therefore, the selectivity curve by Ishida's method for 82 mm mesh net was estimated separately from data for small fish and large fish. There are differences in the slope of the arms and a significant difference between the optimum length. The curve for small fish has a steeper slope than the curve for large fish, especially in the left arm.

Since it was suggested that the selectivity curves for small and large fish differ, the composite selectivity curve of research gillnet was estimated by applying the curve for small fish to 106 mm and smaller meshes, and the curve for large fish to 121 mm and larger meshes.

The compound efficiencies are slightly low for pomfret less than 22 cm and about 30 cm, and slightly high for pomfret more than 35 cm. The coefficient of the variation for the mean of the compound relative efficiency is 7.72 in the fork length range of 16–52 cm. It is suggested that there is no difference in either the index of relative abundance or fork length of fish caught by research gillnet, and this net might act as a non-selective gear for pomfret.